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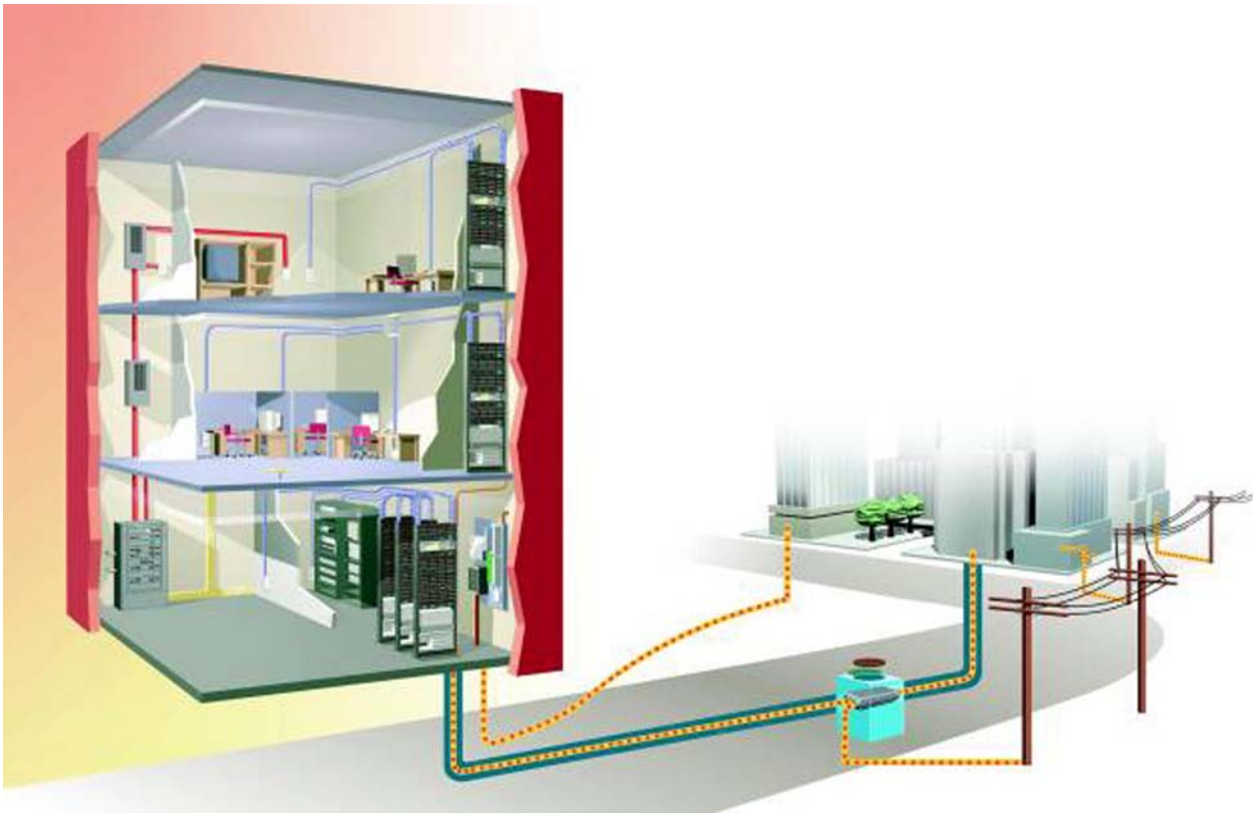
Tips for Ensuring 'Best Quality' Voice-Data-Video Installations



NECA
NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION

Contents

Electrical Design Library (EDL) publications are prepared for architects, consulting engineers, and qualified electrical contractors, as well as owners, developers, investors, and their electrical construction specifying personnel. Issued periodically by the National Electrical Contractors Association (NECA), the publications provide factual explanations of the increasing variety of sophisticated electrical systems and the economics of their installation by professional electrical contractors. They are distributed by the Association’s chapters, located in all sections of the United States. The cover illustration shows the parts of a commercial building that comprise the VDV installation. It is used courtesy of Pass and Seymour/Legrand.

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Abstract

Today's contractors are working in a very competitive field, with more and more firms providing electrical and data communications and low voltage services. One of the best ways to differentiate between contractors is to find one that places a strong emphasis on giving customers a "Best Quality" (BQ) installation. A BQ voice-data-video (VDV) installation is one that follows safety codes, meets or exceeds today's performance standards, transmits without faults, and is performed professionally and cost effectively.

Contractors that emphasize BQ installations recognize that the National Electrical Code (NEC) and National Electrical Installation Standards (NEIS) have installation requirements, while the Telecommunications Industry Association (TIA) offers recommendations related to performance specifications. Taking all these specifications into account before the job is started is what brings about a BQ installation. Table 1 gives a brief picture of required and recommended performance specifications for commercial building installations.

Table 1. Performance Specifications for Commercial Building Installations

NEC Requirements

Category	Chapter	Article
Copper and Fiber Installations		
Sound Systems	6	640
Control and Signaling	7	725
Fire Alarm	7	760
Telecommunications	8	800
CATV and CCTV	8	820
Broadband	8	830
Pathways		
Instrumentation Tray Cable	7	727
Cable Trays	3	392
Firestopping		
Wiring	3	300
Telecommunications	8	800
CATV and CCTV	8	820
Broadband	8	830

NEIS Requirements

Category	Publication
Copper Installations	NEC/BICSI 568
Fiber Installations	NECA/FOA 301
Fire Alarm Systems	NECA 305

ANSI/TIA/EIA Recommendations

Category	Standard	Chapter/Annex
Copper and Fiber Installations		
Copper installations	568-B.1 Addendums	4-11
Copper testing	568-B.1	Annex A, F
Copper, other	568-B.1	Annex J, K, M
Fiber installations	568-B.1	4-6, 10, 11, Annex A, E
Copper cables, hardware, patch cords	568-B.2 Addendums	4-6
Copper testing	568-B.2	Annex A-F
Copper, other	568-B.2	Annex I, J, K, M
Fiber cables, hardware, patch cords, test instruments	568-B.3 Addendums	4-7
Fiber connectors	568-B.3	Annex A
Pathways & Spaces		
Design	569-A/B Addendums	4-8
Color coding, labeling, reports	606-A	5-11
Firestopping		
Firestopping	569-A/B	10.1, Annex A
Color coding, labeling, reports	606-A	5-11

Introduction

Performance plays a major part in delivering quality; proper design is necessary for performance.

When planning a BQ commercial VDV job, you should pay particular attention to certain areas. For the network cabling and design, consider the horizontal and backbone cabling, work area/office cubicle, telecom room, equipment room, and entrance facility. For the pathways and spaces, consider communication rooms/spaces, pathways within and between buildings, and firestopping. For admin/labeling, consider one building with one floor, one building with multiple floors, several buildings (campus), and several locations (nationwide/global). These areas can affect performance by their design/installation as shown below:

- Cabling that is the wrong type can inhibit data transmission. Thus, not only the way the commercial building will be used now, but also in the future, should be considered.
- The backbone cabling must be distance sensitive when the user or customer will be working with transmission speeds such as 100 MHz or 100BASE-T LANs.
- The rooms (telecom, equipment, entrance) need to follow recommended design layouts.
- Pathways, including conduits and raceways, require special considerations because they may be damaged by things in the environment, including foot traffic and electrical interference.
- When outside service providers are bringing in their services, both pathways and well-designed spaces should be allocated for their equipment.
- The Authority Having Jurisdiction is concerned with the firestopping requirements for every installation; therefore, firestopping should be designed for and included in the construction of the project.
- Labeling or marking a building's connection points is highly recommended for troubleshooting and the ongoing maintenance of the telecom infrastructure.

Acting on and taking all of the above into account leads creation of a BQ VDV installation.

Electrical Standards Designed To Yield Quality Installations

The National Electrical Contractors Association (NECA) publishes the National Electrical Installation Standards (NEIS), a series of individual standards providing benchmarks for quality installations. The three standards specifically focus on VDV systems are:

NECA/FOA 301-1997
Standard for Installing and Testing Fiber Optic Cables

NECA 305-2001
Standard for Fire Alarm Systems Job Practices (ANSI)

NECA/BICSI 568-2001
Standard for Installing Commercial Building Telecommunications Cabling (ANSI)

Details about available NEIS can be found on the National Electrical Installation Standards website at *www.neca-neis.org*.

Tips for "Best Quality" Installations

The following tips provide important inforrmation about how to ensure that any type of installation qualifies as a "Best Quality" (BQ) installation.

Tip #1: Horizontal Cabling

Horizontal cabling, which is the cabling that reaches from the telecom room out to the desk or cubicle, is something that must be carefully managed when planning and completing an installation. In order to achieve a BQ installation, the following recommendations apply:

1. The horizontal distance can be up to 90 meters (295 feet).
2. There should be no connections in the horizontal distance except for a transition/consolidation point (under carpet or when connecting between horizontal cables).
3. Cables can be copper Category 3, Category 5e or Category 6, or optical fiber that is 62.5/125 micron or 50/125 micron.
4. There must be two outlets per work area.
5. Grounding for the horizontal cabling system must meet the requirements of the local authorities and the building/safety codes.
6. Additional recommendations for grounding the horizontal cabling system are found in the TIA's J-STD-607-A standard for grounding and bonding.

Tip #2: Backbone Cabling

Backbone cabling, which is the cabling that connects the telecom, other rooms, and other buildings, is another aspect of the job that must be carefully managed when planning and completing an installation. In order to achieve a BQ installation, the following recommendations apply:

1. Typically, backbone cabling is designed with a star topology.
2. Cables used for backbone cabling can be 100-Ohm twisted pair, multimode optical fiber, or singlemode (specified in TIA-568-B.2 and B.3).
3. Distances for data and voice depend on the application and the type of cable. For Category 3 used at 16 MHz or Category 5e used at 100 MHz, typical cabling distance should be about 90m.
4. Access providers may request that a specific distance be provided between the entrance room and the main cross-connect in order to accommodate their design needs.

Tip #3: Work Areas

Work and office areas must accommodate the specific needs of the occupants. Therefore, a BQ installation will take into account those preferences. Specific issues to consider include the following:

1. Cords are 5 meters in length and are included in the horizontal 90 meter distance.
2. A MUTOA (multi-user telecom outlet assembly) could be used to terminate many horizontal cables for a group of cubicles. One MUTOA should serve no more than 12 work areas.
3. If the consolidation point (CP) is used in the open office area, it has to have a different connection for each horizontal cable run.
4. The installation has to be accessible, and yet permanent.
5. The installation should not occupy ceiling spaces.

Tip #4: Telecom Rooms

Telecom rooms generally house cross connections for horizontal and backbone and main cross connect cables, telecom equipment, connecting hardware and splice closures; the demarcation point; fiber from the main cross connect designed as centralized fiber cabling; and grounding and bonding equipment. TRs should not have a false ceiling because of security and there should be a minimum of one telecom room per floor. TIA-569-A provides information for calculating the number of rooms needed.

Tip #5: Equipment Rooms

Equipment rooms generally house cables, connecting hardware, splice closures, grounding and bonding

Table 2. Minimum termination wall length by floor space to be served.

Gross floor space served (sq. ft.)	Wall length (inches)
10,000	39
20,000	42
40,000	68
50,000	90
60,000	96
80,000	120
110,000	144

facilities, protection apparatus, and other equipment for outside plant cable connection to premises cabling. In addition, they house the backbone cable's cross-connect and equipment terminations, and/or access provider trunk terminations, premises network terminations, and auxiliary terminations under control of the building.

The demarcation point, which is mandated by federal/state regulations, electrical protection for access provider equipment, and routing of equipment cables/cords from the main cross-connect or intermediate cross-connect to the telecom equipment may also be located in an equipment room.

The particular design requirements and recommendations for ERs follows:

- ✔ They should only house equipment directly related to the telecom system or environmental support systems.
- ✔ They should be in an accessible location for delivery of large equipment, but that location must have controlled access.
- ✔ The size of the room should be determined by amount of equipment housed there and whether or not it also serves as the entrance facility.
- ✔ The room should be designed for minimum distributed load rating of 100 lbf per square foot and minimum concentrated floor load rating of 200 lbf.
- ✔ The HVAC system must perform to spec.
- ✔ If batteries are present, ventilation and vibration must be accommodated.
- ✔ Equipment rooms should be served by their own electrical supply circuits.
- ✔ Bonding and grounding should always be provided per the specifications.
- ✔ Fire protection specs and water infiltration requirements.

Tip #6: Entrance Facilities

Entrance facilities generally house cables, connecting hardware, protection devices, and other equipment required to connect the OSP to premises cabling; connections for access providers, private network services, or both; the demarcation point; electrical protection; protection on interbuilding backbone cables and antennas; connections by splice or other; and bonding and grounding equipment. The particular design requirements and recommendations for EFs are as follows:

- ✔ The room must to be enclosed if the building is over 20,000 sq. ft.
- ✔ The EF must be next to the electrical service room and there must be controlled access.
- ✔ Room size is determined by the size of the termination frame or the wall terminations, all based on the quantity of cable coming in. If the room's size is larger than specified, it has to be increased to meet the performance specs.
- ✔ When a wall MDF is provided, the space shall be a minimum of 8 feet wide and of sufficient length to house the frame. Table 2 shows minimum termination wall length by floor space to be served.

Tip #7
General Requirements

In addition to the particular requirements listed in tips 4-6, telecom rooms, equipment rooms and entrance facilities ALL require the following:

- ✔ grounding and bonding;
- ✔ fire protection to meet Code requirements;
- ✔ location in the core center of the building and accessible on each floor;
- ✔ interconnection of multiple telecom rooms on one floor by a minimum of one conduit or equivalent pathway;
- ✔ sleeves/slots firestopped according to the code;
- ✔ plywood backboard, 3/4 inches thick, 8 feet high, fire rated, secured to wall;
- ✔ anti-static floors, and floors, walls, ceiling treated to eliminate dust;
- ✔ lighting at a minimum of 50 foot candles 3 feet above the floor;
- ✔ minimum door dimensions of 36 inches wide and 80 inches high, installed to open outward or slide side to side;
- ✔ lockable doors;
- ✔ minimum floor loading of 50 lbf/ft^2;
- ✔ increased floor loading if it will be necessary to accommodate heavier equipment;
- ✔ meet seismic zone requirements;
- ✔ heating, ventilation, and air conditioning available 24 hours per day;
- ✔ a minimum of one air change per hour or to Code;
- ✔ protection against contaminants and pollutants that could affect operation;
- ✔ the ability to handle vibration issues as specified by the equipment manufacturer;
- ✔ sprinkler heads with protective covers; and
- ✔ appropriate labels on all cables, pathways, firestopping, interbuilding cabling, outside plant elements, WAN connections, and grounding and bonding equipment in all rooms.

One good performance design recommendation for these types of installations is to place cable sleeves or slots next to the door to ease pulling of cable.

Tip #8:
Cabling Methods

Depending on the transmission speeds required, different types of copper cabling are recognized as meeting the requirements for a BQ cabling installation. Category 3 copper cabling is recommended for transmissions up to 16 MHz. Category 5e copper cabling is recommended for transmissions up to 100 MHz. Category 6 copper cabling is recommended for transmissions up to 250 MHz.

Several different options are recognized for fiber optics cabling. Three different sizes of multimode fiber—1) 61.5/125 micron optical fiber; 2) 50/125 micron optical fiber; and 3) 850 nm Laser Optimized 50/125 micron multimode optical fiber—are useable for 10 gigabit Ethernet transmission at particular distances.

Category 3, 5e or 6 copper cabling and multimode or singlemode fiber optics cabling are both recommended cabling methods. Another recommended method is centralized fiber, which includes multimode or singlemode fiber limited to 300 meters, including the horizontal, backbone, and patch cords. *Refer to ANSI/EIA/TIA-568-B.1 for recommended installation methods.*

Tip #9:
Pathway Concerns

There are detailed design guidelines for access flooring, cable trays and runways, conduits, pull boxes (for fishing the conduit runs), underfloor duct systems, perimeter raceways that connect surface raceways, sleeves and slots (for access to pathways), and for the design of the floor structure in the ANSI/TIA/EIA-569-A/B standard for Commercial Building Pathways and Spaces.

Generally, pathways should not be in elevators, must be placed in dry locations, and must accommodate applicable seismic zone requirements. Additional guidelines include:

- ✔ ERs, telecommunications rooms, and EF should be connected by the pathways;

Figure 2. Example of an access floor. Courtesy of Pugliese Interior Systems, Inc.

- ✔ cable support systems can be within an access floor or above or below the ceiling, in either plenum or non-plenum form;
- ✔ underfloor duct systems are pathways for services;
- ✔ above-ceiling designs must support the cables so they don't lay directly on the tile or rails;
- ✔ ceiling tiles must be removable or lay-in type;
- ✔ there must be a minimum of 3 inches of clear vertical space above the tiles for the horizontal cabling and pathway;
- ✔ telecommunications cabling can be carried to each area of the floor (zone) by raceways in the ceiling, where permitted by Code, or they can be installed in a conduit, from the TR to the middle of the zone; and
- ✔ NFPA 70, Article 800.52 stipulates separation requirements for electrically conductive telecommunications cable from branch circuits.

There are several good design recommendations for pathway installations, including the following:

- ✔ ceilings can be used for pathways for telecommunications cables or connections;
- ✔ an installed pathway could have cable trays or cable runways included;
- ✔ from the mid-point of a cable install that goes in the ceiling, the cable should be extended down via utility columns or wall conduits; and
- ✔ a cellular floor is generally used in a steel frame building in floors located above grade.

Tip #10: Firestopping

Firestops prevent fire, smoke, or water from passing through a barrier penetration. Firestopping is required for cabling performance and is a part of the ANSI/TIA/EIA-569-A/B Pathways and Spaces standard. Designers should reference reports on barrier materials before choosing the best floor or wall design for a fire zone perimeter.

Mechanical firestop systems are premanufactured elastomeric components shaped to fit around standard cables, tubes, or conduits. Non-mechanical firestop systems—such as putty, caulk, cement-line materials, intumescent sheets, intumescent wrap strips, silicon foams, and premanufactured pillows—share the benefit of adapting to irregular openings and off-center penetrating items.

Keep in mind when designing firestopping installations that receptacles and switch boxes need to be firestopped on the back side of the units where jurisdiction mandates. Additional recommendations are as follows:

- ✔ All penetrations—openings made in fire-rated barriers to install building elements (e.g., conduits, cables, piping, ducts)—must protected by approved firestops.
- ✔ Installation criteria must be listed in the installation instructions in order for the AHJ to issue a certificate of occupancy.
- ✔ The firestopping spec must accommodate applicable

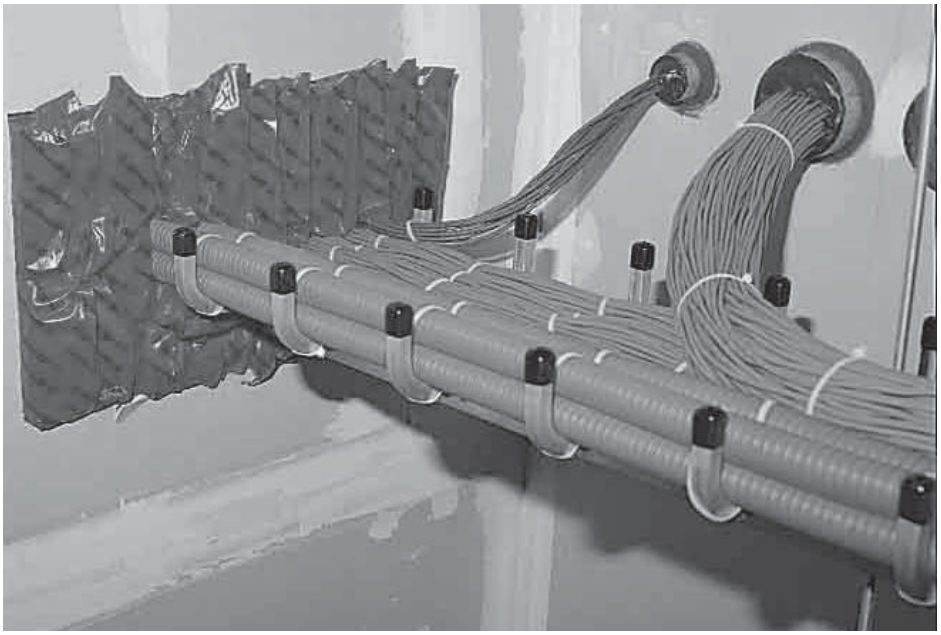

Figure 3. Example of firestopping used in a voice and data cabling scenario. Courtesy of Specified Technologies, Inc.

seismic zone requirements.

- ✔ The equipment used in firestop systems must be the same as the products used in the fire qualification tests.

For firestopping installations, the choice and the plan for design of firestop products should be made by qualified technical personnel of a manufacturer and should pertain only for a specific job and location. No additional firestopping is needed electrical equipment such as boxes, junction boxes, breaker panels and fixtures that have been tested and approved for use in fire-rated assemblies. ANSI/TIA/EIA-568-A/B provides a checklist for meeting the firestopping needs of the customer.

Tip #11: Admin/Labeling

A quality design delivers an infrastructure that is properly labeled so the customer can efficiently troubleshoot and administer their system. A building's design must make room for a label's visibility and correctness, while at the same time allowing room for potential growth. Working with a labeling philosophy brings about an infrastructure design that is understandable and organized. All aspects of the project are accounted for which can ensure the success of a BQ VDV installation.

The horizontal cabling, backbone cabling, the grounding and bonding system, pathways and spaces, and firestopping locations should all be labeled. Before labeling begins, the project should be assessed to determine the appropriate labeling scheme: Class 1, 2, 3, or 4. Class 1 installations, involving a premises served by one telecommunications room, require labels on the telecommunications room, horizontal link, and main grounding busbar. Class 2 installations, involving a single building with multiple telecommunications rooms, require the same labeling as for Class 1, plus intrabuilding backbone cable, intrabuilding backbone pairs/strands, telecommunications grounding busbar, and firestop location. Class 3 installations, involving a campus and its buildings and outside plant elements, require the same labeling as for Class 2, plus interbuilding backbone, interbuilding backbone pairs/strands, each building. Class 4 installations, involving a multi-site system, required the same labeling as for Class 3, plus labeling of each site location.

Labels should be added for horizontal or intrabuilding backbone pathway elements, horizontal or intrabuilding backbone pathways between two TRs or areas, outside plant pathway elements, interbuilding pathways or elements, wide area network links, and private network links.

Conclusion

Many performance issues need to be covered to bring about a BQ installation. The most important one is to include performance requirements in the design before the work begins. If the performance standards of work are recognized, along with the requirements listed in the NEC, the job will become a BQ VDV installation.

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